

Welcome to NASA Applied Remote Sensing Training (ARSET) Webinar Series

Introduction to NASA Earth Science Data Products, Portals, and Tools

Course Dates: 16, 23, 30 September and 7, 14 October 2014



ATMOSPHERE



CALIBRATED RADIANCE AND
SOLAR RADIANCE



CRYOSPHERE



HUMAN DIMENSIONS



LAND



OCEAN

ARSET

Applied Remote Sensing Training
A project of NASA Applied Sciences



Important Information

Presentations URL:


<http://arset.gsfc.nasa.gov/>

Contact for Requesting Recorded Link for the Webinars:

Marines Martins : marines.martins@ssaihq.com

Past Presentations

<http://arset.gsfc.nasa.gov/>

**ARSET**
Applied Remote Sensing Training

Earth Science Division Applied Sciences ASP Water Resources

DISASTERS ECO FORECASTING HEALTH & AIR QUALITY WATER RESOURCES


ARSET

- Webinars
- Workshops
- Apply for Training
- Personnel
- Links
- Upcoming Webinar




Upcoming Courses

Airquality, Disasters, Ecoforecasting, Water Resources **Introduction to NASA Earth Science Data Products, Portals, and Tools**
09/16/2014 to 10/14/2014

Introduction to NASA Earth Science Data Products, Portals, and Tools
09/16/2014 to 10/14/2014
Times: Tuesdays (5 one-hour sessions), 8-9 AM U.S. Eastern Standard Time (13 PM UTC)
GIS: True
Keywords: **Satellite Imagery, Tools**
Instruments: **Aqua, Landsat, Terra, TRMM**

 **Webinar Information**

Presentations and Recordings

Week	Date	Title	Presentation	Recording	Assignment
1	Sept. 16, 2014	NASA Earth Science: <i>Research and Applications to Decision Support</i>	 Session-1 (click)	View	N/A
2	Sept. 23, 2014	Overview of NASA Earth Science Data Products: Remote Sensing and Earth System Modeling Data	 Session-2 (click)	View	N/A
3	Sept. 30, 2014	NASA Data Centers and Data Access Tools	 Session-3 (click)	View	N/A

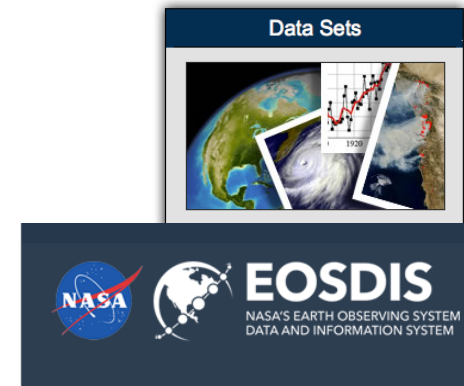
Course Outline

Week 1



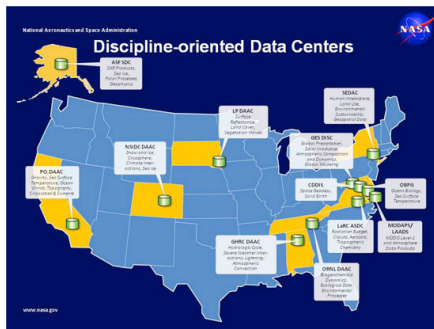
NASA Earth Science

Week 2



NASA Data Products

Week 3



NASA Data Centers

Week 4 & Week 5

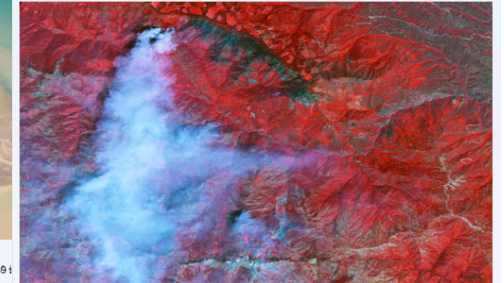
Application & Capacity Building: Application Areas

Water Resources



NASA's Landsat satellites shows the Yellow River delta at five-year intervals from 1989 to 2014.

Disasters



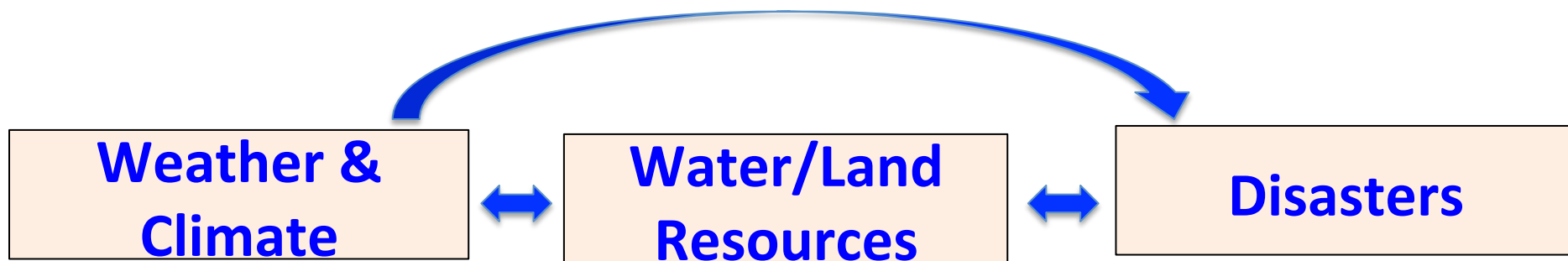
NASA supports California wildfire control efforts with an unmanned plane. read more...

NASA Data Applications with GIS
Disasters and Land Resource Management

Week 5 Outline

NASA Data for Disasters and Land Resources Management

- **Data, Websites, Tools**
- **Live Demonstrations of:**
 - *Global Flood Monitoring System (GFMS)*
 - *MODIS Inundation Mapping Tool (with GIS)*
 - *GEO-GLAM/Crop Monitor*
 - *LandsatLook*



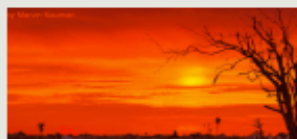
NATURAL DISASTERS



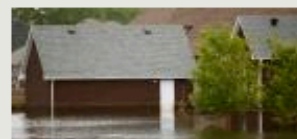
[Drought >](#)



[Earthquakes >](#)



[Extreme Heat >](#)



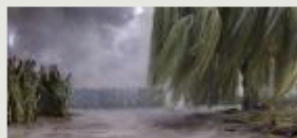
[Floods >](#)



[Hurricanes >](#)



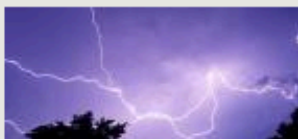
[Landslides & Debris Flow >](#)



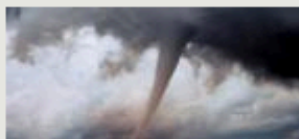
[Severe Weather >](#)



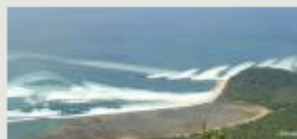
[Space Weather >](#)



[Thunderstorms & Lightning >](#)



[Tornadoes >](#)



[Tsunamis >](#)



[Volcanoes >](#)



[Wildfires >](#)



[Winter Storms & Extreme Cold >](#)

<http://www.ready.gov>

Disaster Management



Live Demo



Earthquake

Tsunamis

Volcanoes

Lightning

Wild Fire

Hurricanes

Extreme Rain/
Severe Weather

Flooding

Landslides

Drought

Satellites/Sensors for Disasters

Satellite	Sensors	Quantities (Disasters)
TRMM/ (GPM)*	Precipitation Radar (PR) /DPR TRMM Microwave Imager (TMI) /GMI Visible Infrared Scanner (VIRS) Lightening Imaging Sensor (LIS)	Rain Rate, Vertical Rain Rate Profile, Accumulated Rain, Soil Moisture (Extreme Rain, Floods, Drought, Tropical Cyclones, Lightening)
Terra and Aqua	MODerate Resolution Imaging Spectroradiometer (MODIS)	Snow Cover, Clouds, Reflectance, Vegetation Index, Land Cover (Inundation, Fire Detection, Volcanic Ash, Drought)
Aqua	Atmospheric Infrared Sounder (AIRS)	3-dimensional Atmospheric Temperature and Humidity, clouds (Extreme Weather, Storms, Extreme Heat)

* Launched on February 27, 2014 with GPM Microwave Imager (GMI) and Dual Frequency Precipitation Radar (DPR)

Satellites/Sensors for Disasters

Satellite	Sensors	Quantities (Disasters)
Landsat	(Enhanced) Thematic Mapper (ETM)	Vegetation Index, Leaf Area Index, Land Cover (Drought, Fire)
Grace	K-Band Ranging Assembly	Terrestrial Water (Drought)
RadraSat, ENVISAT, ERS-1 and -2 Global Positioning Satellite	Synthetic Aperture Radar (SAR)	Crustal Deformation (Earthquakes, Tsunamis)
Terra	Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)	Surface Kinetic Temperature and Emissivity, Surface Radiance (VNIR,SWIR)*, Digital Elevation Model (Volcanoes, Floods)

* Visible and Near Infrared (VNIR) and Shortwave Infrared (SWIR)

Earthquakes

<http://solidearth.jpl.nasa.gov/>



[Deformation, Ecosystem Structure, and Dynamics of Ice \(DESDynI\)](http://desdyni.jpl.nasa.gov)

Earth's surface and interior are undergoing a constant process of change. Variations in the ice sheets and land cover impact the climate and the environment. Violent events such as earthquakes, volcanic eruptions, landslides, and floods reshape the surface and pose significant hazards. DESDynI is a proposed dedicated U.S. InSAR and LIDAR mission optimized for studying hazards and global environmental change.

<http://desdyni.jpl.nasa.gov>



Global Earthquake Satellite System (GESS) – future plan to build constellation to monitor fault systems

http://solidearth.jpl.nasa.gov/GESS/GESS_Rep_2003_20_Yr_Plan.pdf

Earthquakes

<http://solidearth.jpl.nasa.gov/PAGES/quake04.html>



Multiple Research-to-Application Projects being supported by NASA to map crustal deformation by using satellite data

NASA'S RESEARCH: EARTHQUAKES

CURRENT NASA PROJECTS:

A Neotectonic Map of the Earth: A Pilot Study of SRTM Data

Combined Analysis of Synthetic Aperture Radar (SAR) Interferometric and Global Positioning System (GPS) Data for Southern California Crustal Deformation Studies

Correcting Deformation Rates from the SCIGN Network for the Effects of Human-induced Ground Movements

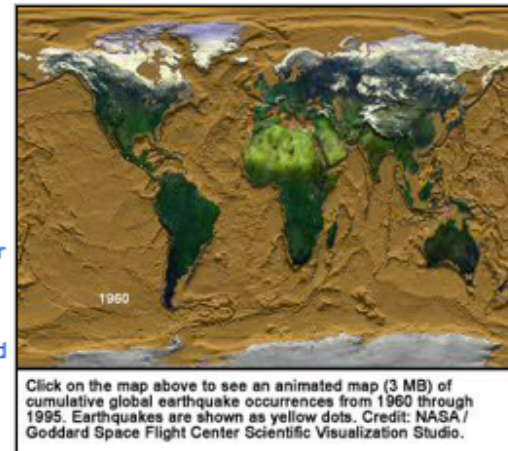
Crustal Deformation and Earthquake Hazard in the Subduction Zones of Southern Alaska and the North Island of New Zealand

Demonstrating the Application of Space-borne Interferometric Synthetic Aperture Radar (InSAR) to the Detection and Monitoring of Subsidence Caused by

Ground-Water Pumping

Development of a Fully Three-Dimensional Model of Interacting Fault Systems for Interpretation of GPS and InSAR Observations

Earthquake Hazards in the Eastern Mediterranean



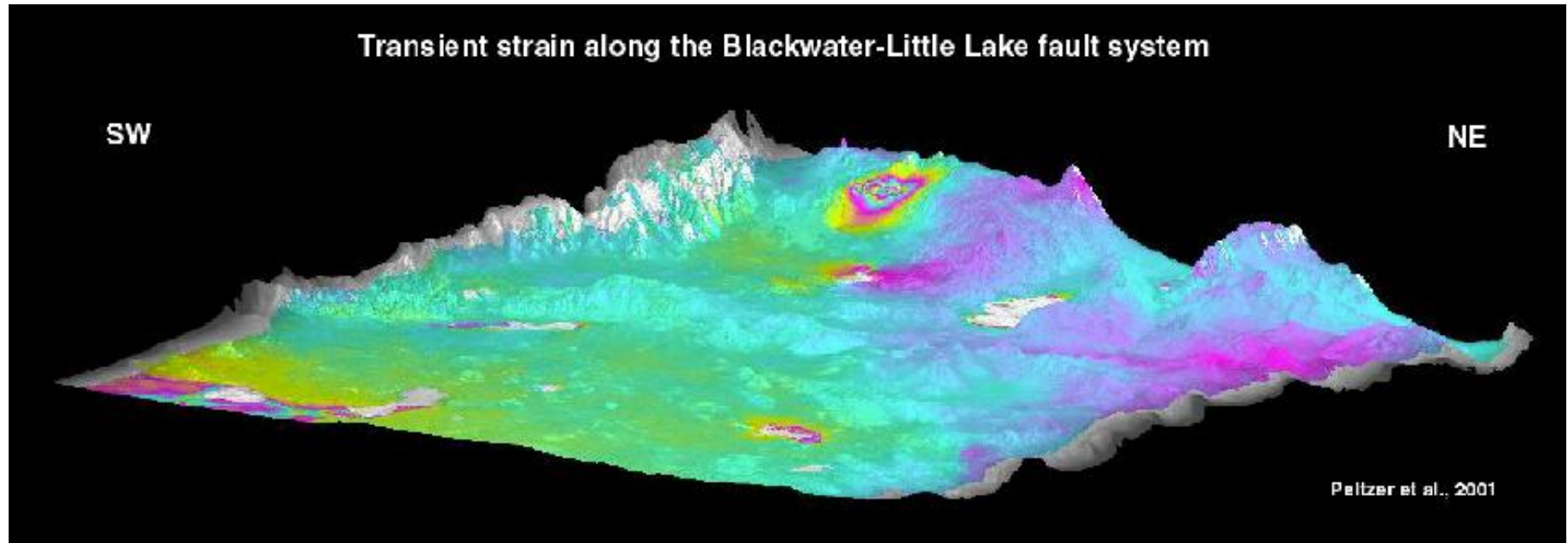
Example shown in the next slide

Earthquakes

<http://www-radar.jpl.nasa.gov/insar4crust>

Synthetic Aperture Radar (SAR) and Global Positioning Satellite (GPS) are used to map crustal deformation

SAR Satellites: RadraSat, ENVISAT, ERS-1 and -2



InSAR view of the Eastern California Shear Zone

From Gilles Peltzer , JPL, UCLA

Tsunamis

<https://earthdata.nasa.gov/data/data-centers/cddis>

Discover Data & Services

Data and Service Access Client
Reverb

Dataset Directory
GCMD

Search & Order Tools

EOSDIS Data Service Directory

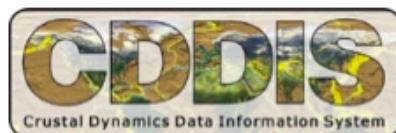
Related Content

- [Sizing a tsunami](#)
- [When a day is not a day](#)
- [Where on Earth?](#)
- [Earth's crust in action](#)
- [A snag in space-time](#)

Home

Crustal Dynamics Data Information System (CDDIS)

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The CDDIS is NASA's data archive and information service supporting the international space geodesy community. CDDIS provides continuous, long term, public access to the data and derived products from a global network of observing stations equipped with one or more of the following measurement techniques:

- GNSS-Global Navigation Satellite System (GNSS),
- Satellite Laser Ranging (SLR),
- Lunar Laser Ranging (LLR),
- Very Long Baseline Interferometry (VLBI), and
- Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS):

as well as products derived from these data required for a variety of science observations, including the determination of a global terrestrial reference frame and geodetic studies in plate tectonics, earthquake displacements, volcano monitoring, Earth orientation, and atmospheric angular momentum, among others.

Users can access the data and products available through the CDDIS via [anonymous ftp](#).

- [Space Geodesy](#)
- [Solid Earth](#)

Contact Information

Carey Noll, *DAAC Manager*
Patrick Michael, *Deputy DAAC Manager*
URL: <http://cddis.gsfc.nasa.gov>
FTP: <ftp://cddis.gsfc.nasa.gov>



The figure illustrates the global networks of geodetic sites which consist of 440 GNSS receivers, 44 laser ranging sites, 45 VLBI stations, and 58 DORIS sites and provides the means of determining an accurate and global Terrestrial Reference Frame. Courtesy: CDDIS

Tsunamis

<https://earthdata.nasa.gov/data/data-centers/cddis>

Global Navigation Satellite Systems (GNSSs)

For more information

NASA Crustal Dynamics Data Information System (CDDIS)

NASA Global Differential GPS System (GDGPS)

About the data used

Satellite	Global Navigation Satellite System (GNSS)
Sensor	GNSS Receivers
Data set	GNSS Data Archive
Resolution	30 second or more frequent
Parameter	Latitude and longitude
Data center	NASA Crustal Dynamics Data Information System (CDDIS)

About the CDDIS GNSS data and products archive

Global Navigation Satellite Systems (GNSSs), such as the U.S. GPS, the Russian GLONASS, and the European Galileo system, provide autonomous geo-spatial positioning with global coverage. Ground (or space-based) receivers collect the signals from orbiting satellites to determine their location in three dimensions and calculate precise time. These receivers detect, decode, and process both pseudorange (code) and phase transmitted by GNSS satellites.

Since 1992, the CDDIS has supported GNSS data and product archiving for the International GNSS Service (IGS) as one of four global data centers. In this capacity, the CDDIS provides online access to the GNSS data generated by the IGS network as well as the IGS standard, working group, and pilot project products derived from these data.



GNSS receivers detect, decode, and process signals from the GNSS satellites (e.g., GPS, GLONASS, Galileo, BeiDou, and others). The satellites transmit the ranging codes on two radio-frequency carriers, allowing the locations of GNSS receivers to be determined with varying degrees of accuracy, depending on the receiver and post-processing of the data.

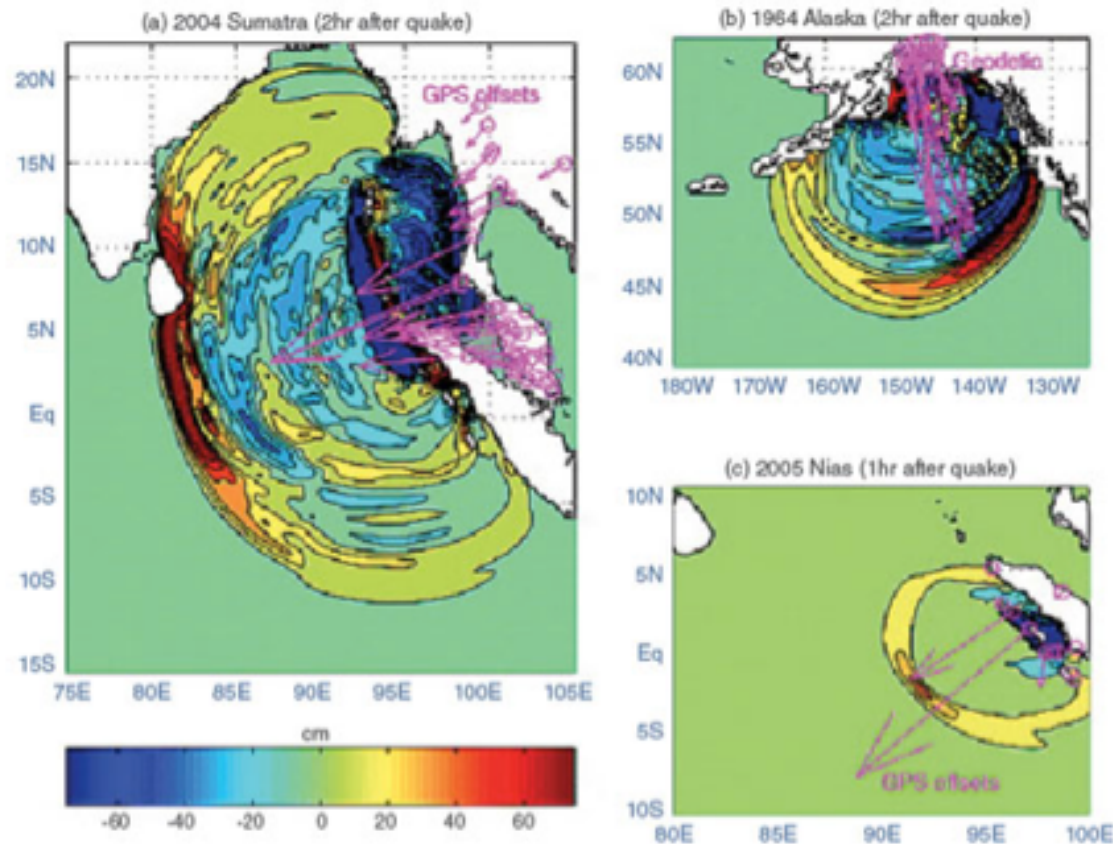
References:

- NASA Crustal Dynamics Data Information System. Updated daily. Global Navigation Satellite System (GNSS) Data Archive. Greenbelt, Maryland USA.
- Song, Y. T. 2007. Detecting tsunami genesis and scales directly from coastal GPS stations. *Geophysical Research Letters* 34, doi: 10.1029/2007GLO31681.
- Song, Y. T., I. Fukumori, C. K. Shum, and Y. Yi. 2012. Merging tsunamis of the 2011 Tohoku-Oki earthquake detected over the open ocean. *Geophysical Research Letters* 39, doi:10.1029/2011GL0050767

Tsunamis

<https://earthdata.nasa.gov/data/data-centers/cddis>

Data from GNSS/Global Positioning Satellite



Pink arrows are the GPS displacement

Courtesy:
T. Song, 2007,
Geophysical
Research
Letters, 34,
[doi:
10.1029/2007G
LO31681](https://doi.org/10.1029/2007GL031681).

GPS data used to detect tsunami severity and direction after an earthquake. Tested the technique for three historic earthquakes and predicted the resulting tsunamis: (a) the 2004 Indian Ocean tsunami two hours after the quake, (b) the 1964 Alaska tsunami two hours after the quake, and (c) the 2005 Nias tsunami one hour after the quake.

Volcanoes

<http://ava.jpl.nasa.gov/>

The screenshot shows the homepage of the ASTER Volcano Archive (AVA). At the top, there is a NASA logo and the text "Jet Propulsion Laboratory California Institute of Technology" with a "Login" button. Below this is a navigation bar with links: "JPL HOME", "EARTH", "SOLAR SYSTEM", "STARS & GALAXIES", and "TECHNOLOGY". The main header features a large "AVA" logo and the text "ASTER VOLCANO ARCHIVE" over a background image of a volcano. Below the header is another navigation bar with links: "AVA HOME", "SEARCH", "ABOUT THE AVA", "RESEARCH", and "LINKS". A paragraph of text describes the archive: "The ASTER Volcano Archive (AVA) is the worlds largest specialty archive of volcano data. For 1,546 recently active volcanos listed by the Smithsonian Global Volcanism Program, the AVA has collected the entirety of high-resolution multispectral ASTER data and made it available to the public. Also included are digital elevation maps, NOAA ash advisories, alteration zone imagery, and thermal anomaly reports. LANDSAT7 data are also being processed. Feel free to browse the archive!". Below this text is a search bar labeled "Search for Volcanos:". Further down, there are four thumbnail images with labels: "View Recent Imagery", "View Recent Ash Advisories", "Recent Thermal Anomalies", and "Alteration Zone Maps". Below these are two more thumbnails labeled "Google earth" and "Google maps". At the bottom, a paragraph states: "The AVA has been designed for both the science community and the public at large. As of October 13, 2014 the AVA contains 159,273 individual ASTER granules, 16,656 NOAA reports, 1,216 digital elevation maps, 5,113 thermal anomaly detections, along with various other associated products." The footer contains logos for "USA.gov", "JPL", and "NASA".

NASA Jet Propulsion Laboratory California Institute of Technology

Login

JPL HOME EARTH SOLAR SYSTEM STARS & GALAXIES TECHNOLOGY

AVA HOME SEARCH ABOUT THE AVA RESEARCH LINKS

The ASTER Volcano Archive (AVA) is the worlds largest specialty archive of volcano data. For 1,546 recently active volcanos listed by the Smithsonian Global Volcanism Program, the AVA has collected the entirety of high-resolution multispectral ASTER data and made it available to the public. Also included are digital elevation maps, NOAA ash advisories, alteration zone imagery, and thermal anomaly reports. LANDSAT7 data are also being processed. Feel free to browse the archive!

Search for Volcanos:

View Recent Imagery View Recent Ash Advisories Recent Thermal Anomalies Alteration Zone Maps

Google earth Google maps

The AVA has been designed for both the science community and the public at large. As of October 13, 2014 the AVA contains 159,273 individual ASTER granules, 16,656 NOAA reports, 1,216 digital elevation maps, 5,113 thermal anomaly detections, along with various other associated products.

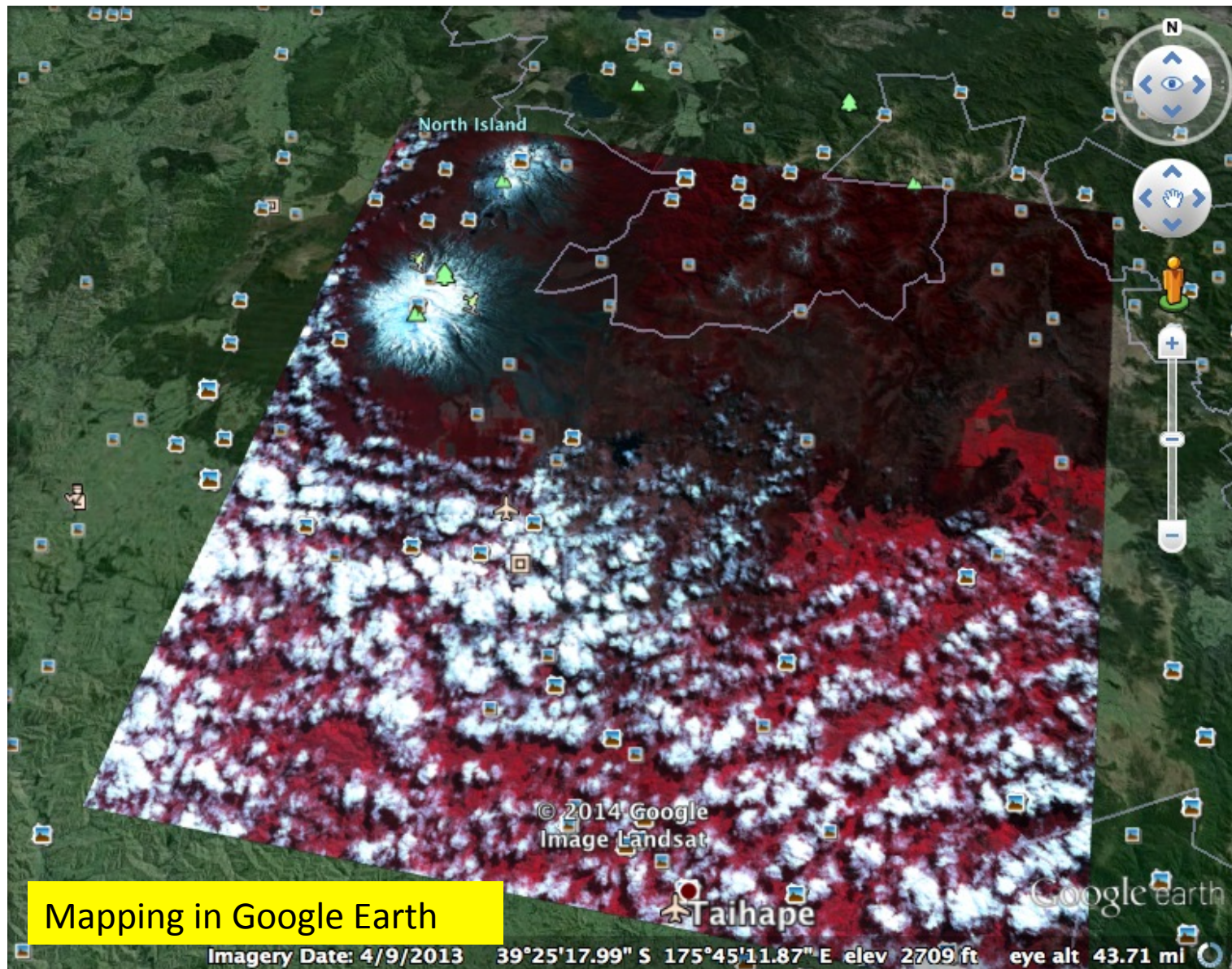
USA.gov JPL NASA

USES ASTER VNIR,
TIR to map
Volcanoes

Recent Volcanic
Activities

Terra/ASTER Image of Volcano Over New Zealand on October 8, 2014

<http://ava.jpl.nasa.gov/>



Mapping in Google Earth

Lightning

<http://thunder.msfc.nasa.gov/data/>

Lightening
Imaging
Sensor (LIS)
Data from
TRMM
Satellite

Lightning & Atmospheric Electricity Research at the GHCC

Learn more about the GHCC Lightning Team >> Thursday, October 9, 2014

Home

- The GHCC Lightning Team
- A Lightning Primer
- Dataset Information**
- Space Research and Observations
- Field Campaigns and Ground Validation
- File Cabinet and Bookshelf
- Global Lightning Image
- Contact Us
- Government Compliance
- Privacy, Security, Notices

A Lightning Primer
A historical essay on lightning research. This primer describes the characteristics of lightning and provides information on recent activities in lightning research.
More >>

Field Campaigns and Ground Validation
An overview of field programs in which the Lightning Team has participated, including a description of some of the instruments that were used.
More >>

Dataset Information
Access to data from the Lightning Team's experiments, information about the data, and links to other sources of lightning data.
More >>

Space Research and Observations
Learn about LIS, OTD, LMS, and other space based lightning detection instruments designed, built, and maintained by the Lightning Team.
More >>

File Cabinet and Bookshelf
Documents, reports, press releases, and an assortment of other information related to our research activities.
More >>

Global Lightning Image
Global lightning strikes from January 1998 to present day from the NASA/MSFC Lightning Imaging Sensor.
More >>

NASA Contact: Rahul Ramachandran
For information: GHRC User Services Office
Site Curator: LIS Webteam

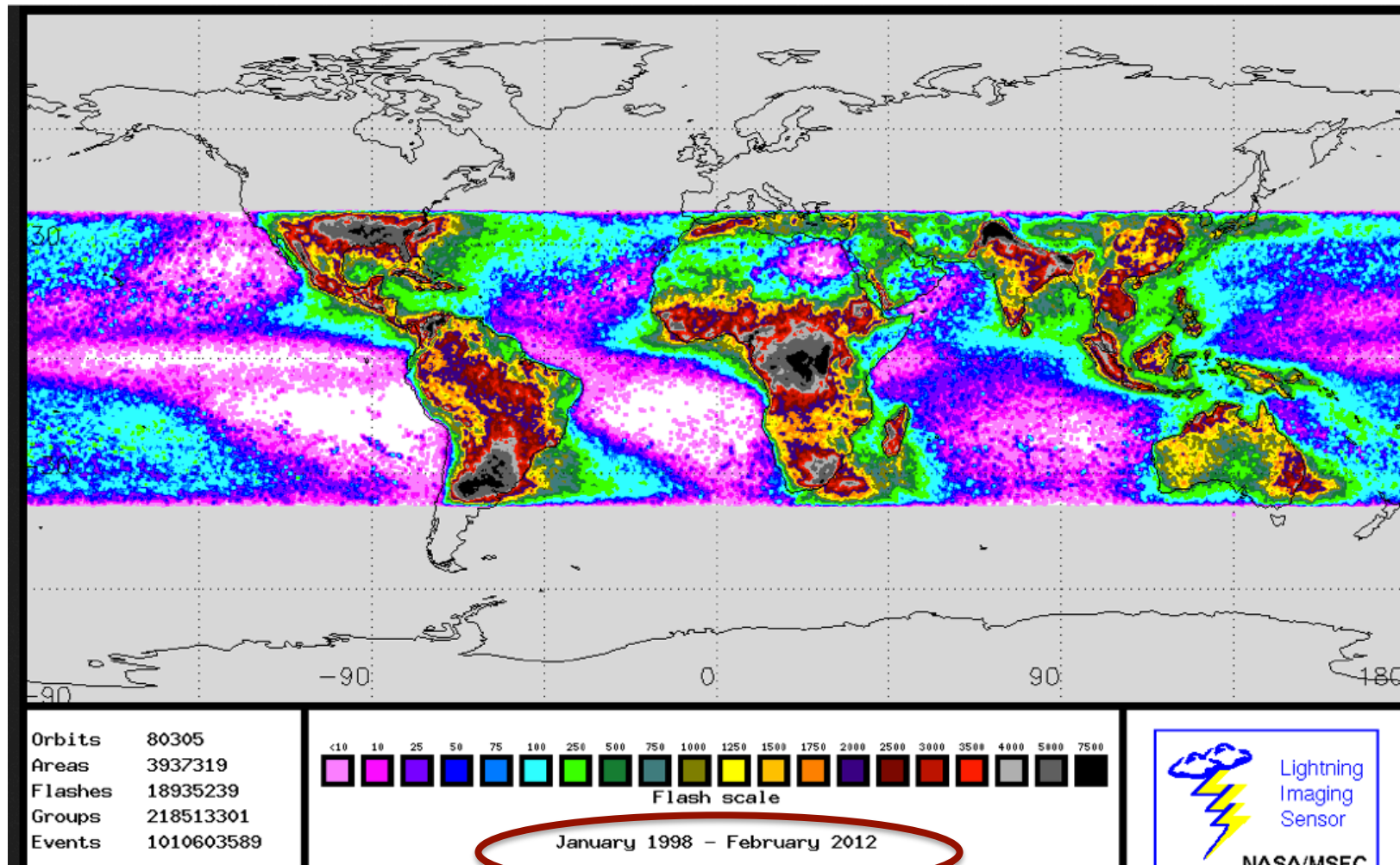
Banner lightning photographs © Wes Thomas

Global Hydrology Climate Center (GHCC)

Lightning

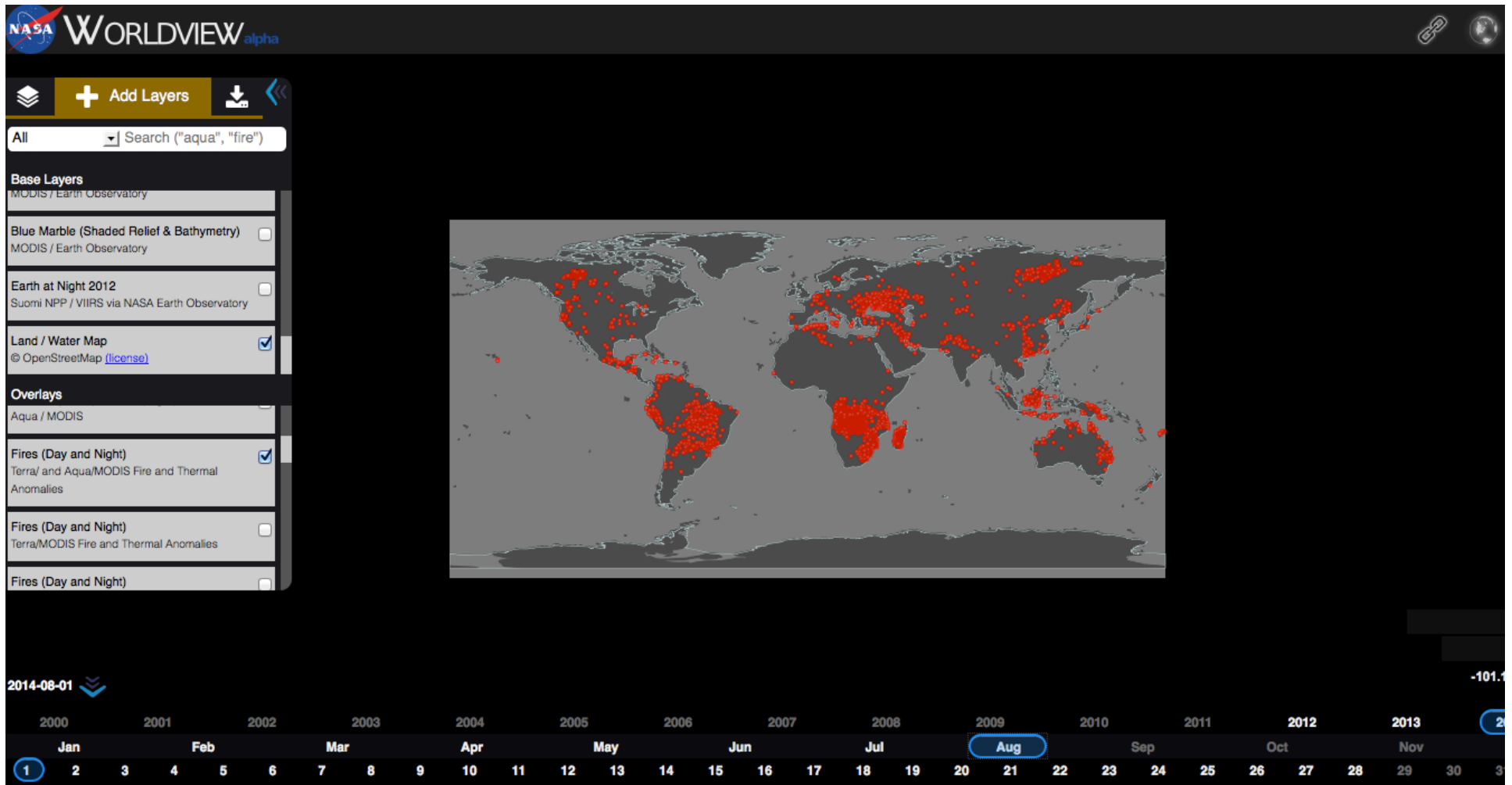
<http://thunder.nsstc.nasa.gov/lis/>

The Lightning Imaging Sensor (LIS) on-board TRMM detects lightning over the tropics



Global Fire Detection (Terra & Aqua)

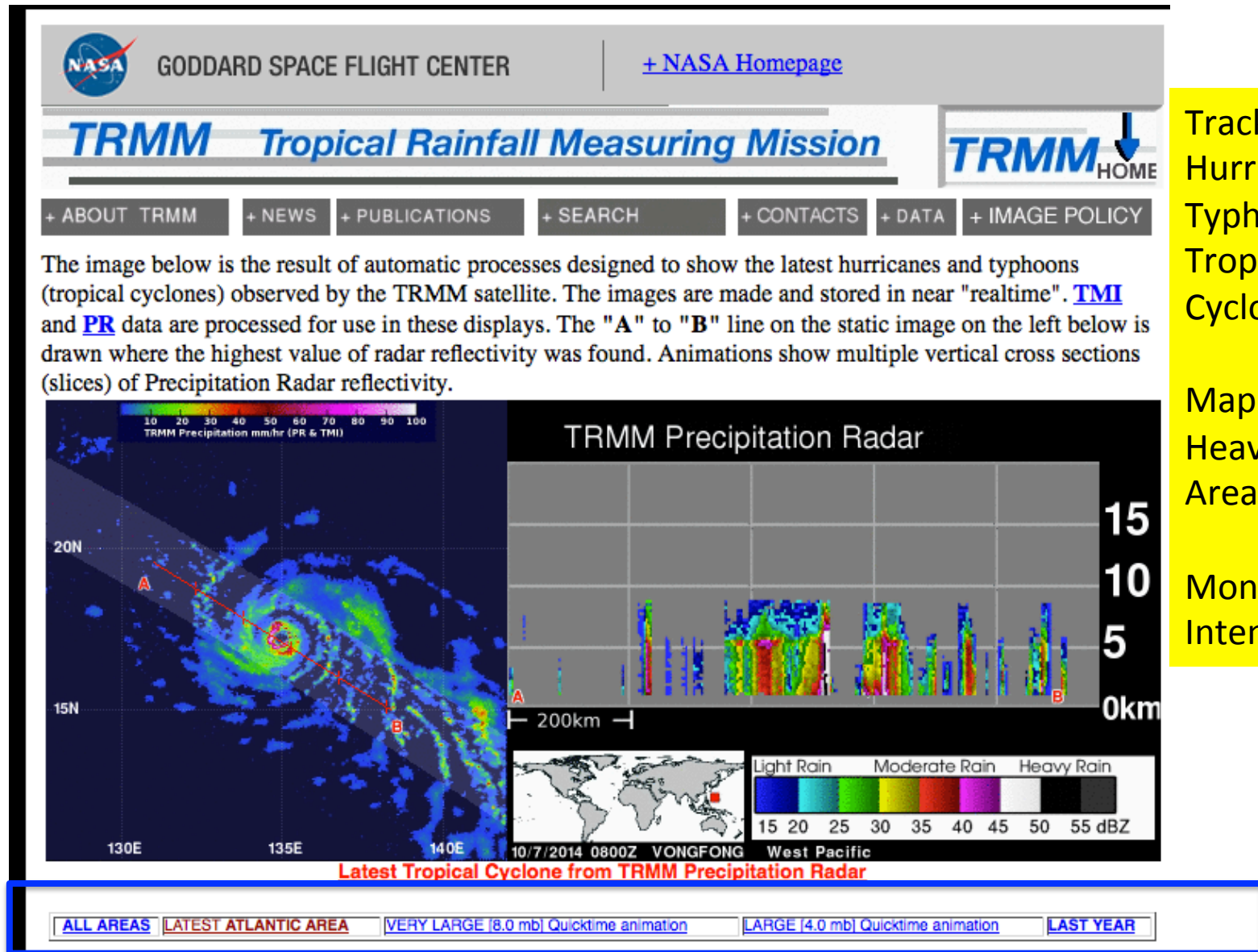
<https://earthdata.nasa.gov/labs/worldview/>



Hurricanes, Extreme Rain, and Flooding

Hurricane (Rainfall)

http://trmm.gsfc.nasa.gov/publications_dir/multi_resource_tropical.html



Tracking
Hurricanes/
Typhoons/
Tropical
Cyclones

Mapping
Heavy Rain
Areas

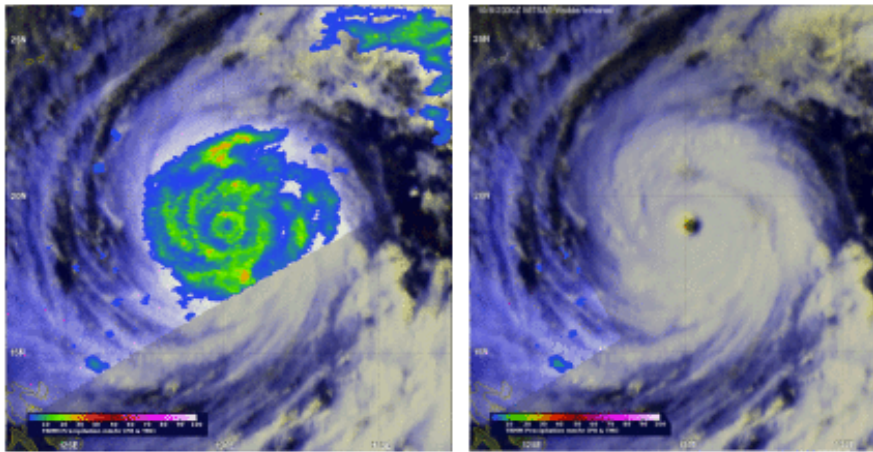
Monitoring
Intensity

Hurricane

http://trmm.gsfc.nasa.gov/publications_dir/multi_resource_tropical.html

TRMM tracks widespread rainfall associated with recent tropical systems

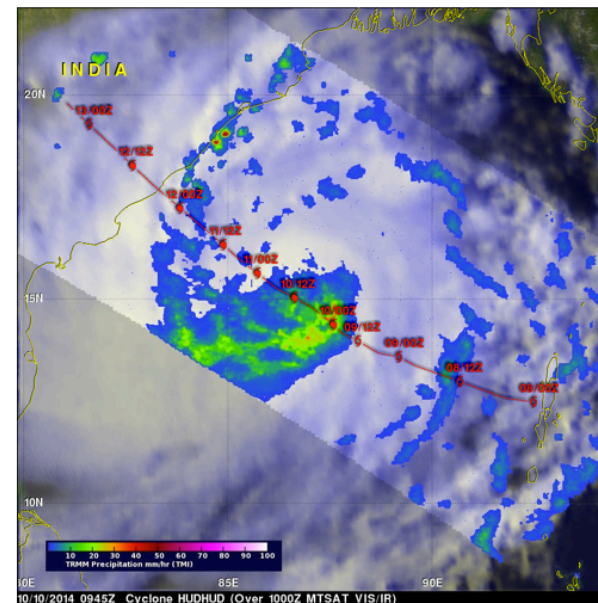
TOP STORY



Recent Super Typhoon Vongfong near Japan seen from TRMM on 9th October 2014

Friday, October 10, 2014

TRMM Sees Intensifying Cyclone Hudhud




Recent Indian Ocean Cyclone Hudhud seen from TRMM on 10th October 2014

Hurricane

http://www.nasa.gov/mission_pages/hurricanes/main/index.html#.VDdGgedDSIQ

Hurricanes and Cyclones Observed by Different NASA Missions

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Hurricanes

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Research Team


► Missions


News Archives

All NASA Missions

Connect: Hurricane Updates





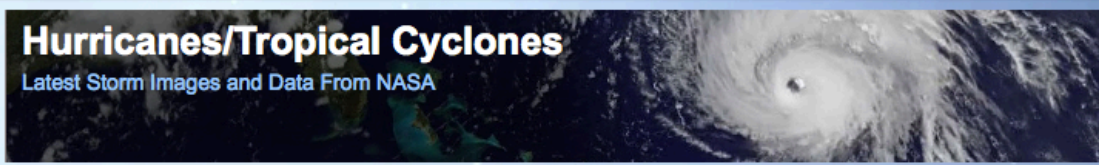


Hurricane Breaking News

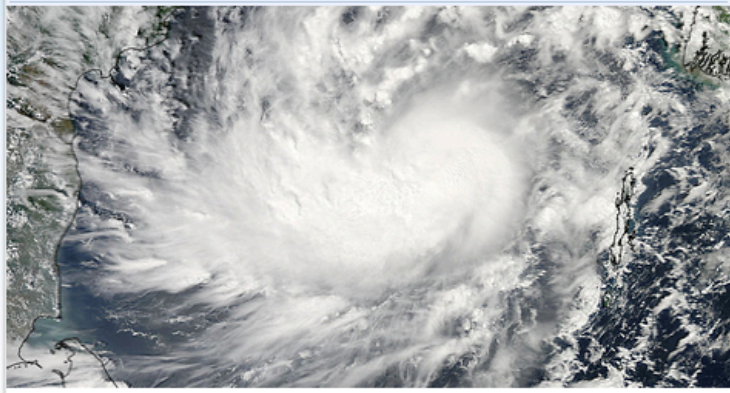
Subscribe

Hurricanes/Tropical Cyclones

Latest Storm Images and Data From NASA



Latest Storm Updates





NASA Eyes Tropical Cyclone Hudhud as Warnings Posted for East-Central India

Aqua flew over Hudhud on Oct. 9 and showed it was still somewhat elongated, but more organized than the previous day.

Hurricane Tweets


Hurricane Tweets



 **NASAHurricane** ✓
@NASAHurricane 7h

ATLANTIC OCEAN- Now watching System 99L!
Shower and thunderstorm activity, associated with a broad surface low... [fb.me/6RoawEu9y](https://www.facebook.com/6RoawEu9y)

Expand

 **NASAHurricane** ✓
@NASAHurricane 8h

NW PACIFIC *Full Update* NASA's Aqua Satellite Tracking Super Typhoon Vongfong in the Philippine Sea
NASA's Aqua... [fb.me/3lPKJY3bK](https://www.facebook.com/3lPKJY3bK)

Global Disaster Alert and Coordination System (GDACS)

<http://www.gdacs.org>

Earthquakes, Floods, Tropical Cyclones



TRMM rainfall and hurricane information used operationally, in addition to other products, by GDACS

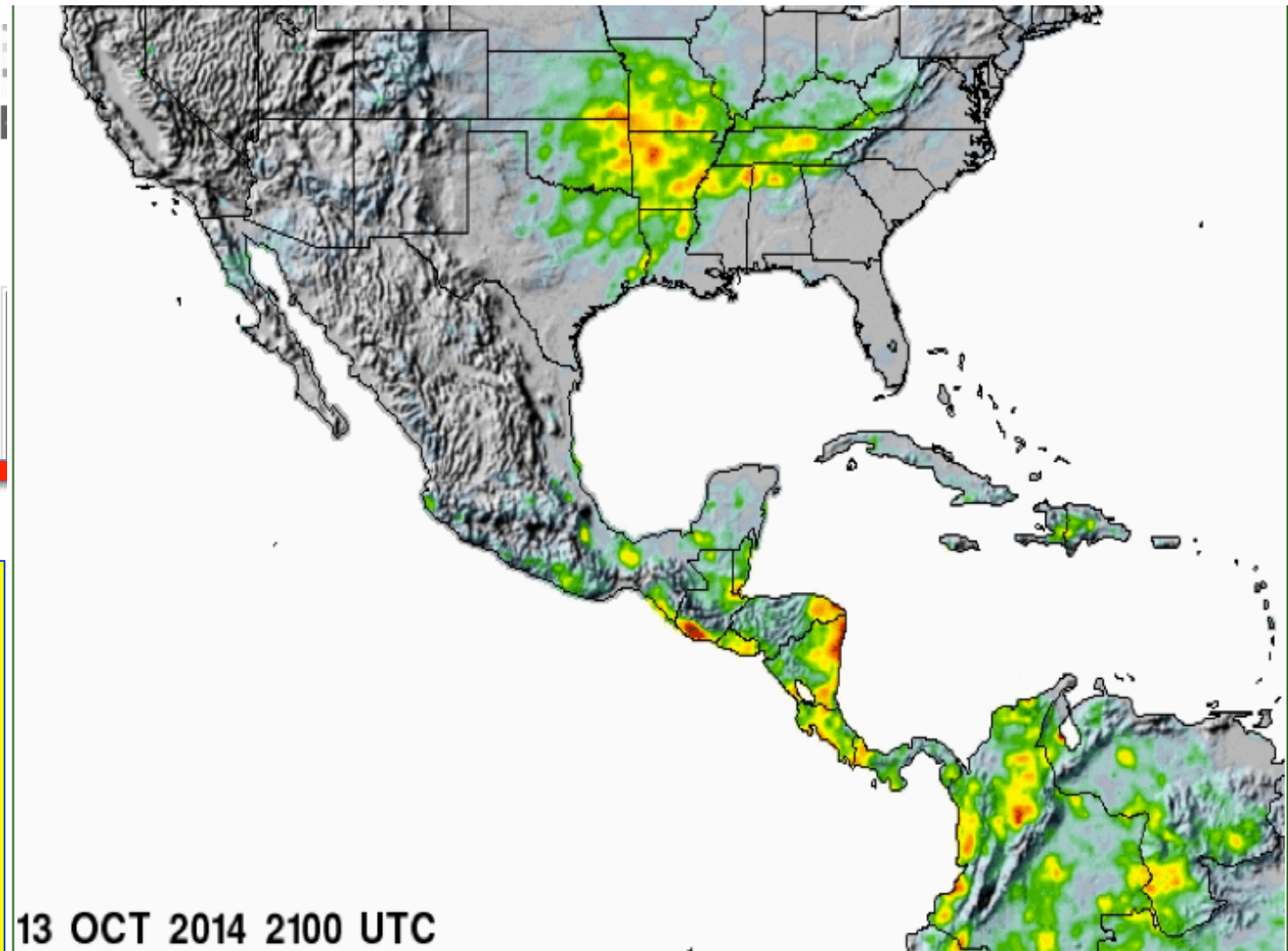
Tropical Rainfall Measuring Mission (TRMM)-based Flooding Tools

- **TRMM Current Heavy Rain, Flood and
Landslide Estimation**
http://trmm.gsfc.nasa.gov/publications_dir/potential_flood_hydro.html
- **Global Flood Monitoring System (GFMS)**
<http://http://flood.umd.edu/>

These tools use TRMM near-real time rainfall as input to hydrology models to diagnose flooding conditions

Extreme Rain, Landslide, and Flooding

http://trmm.gsfc.nasa.gov/publications_dir/potential_flood_hydro.html



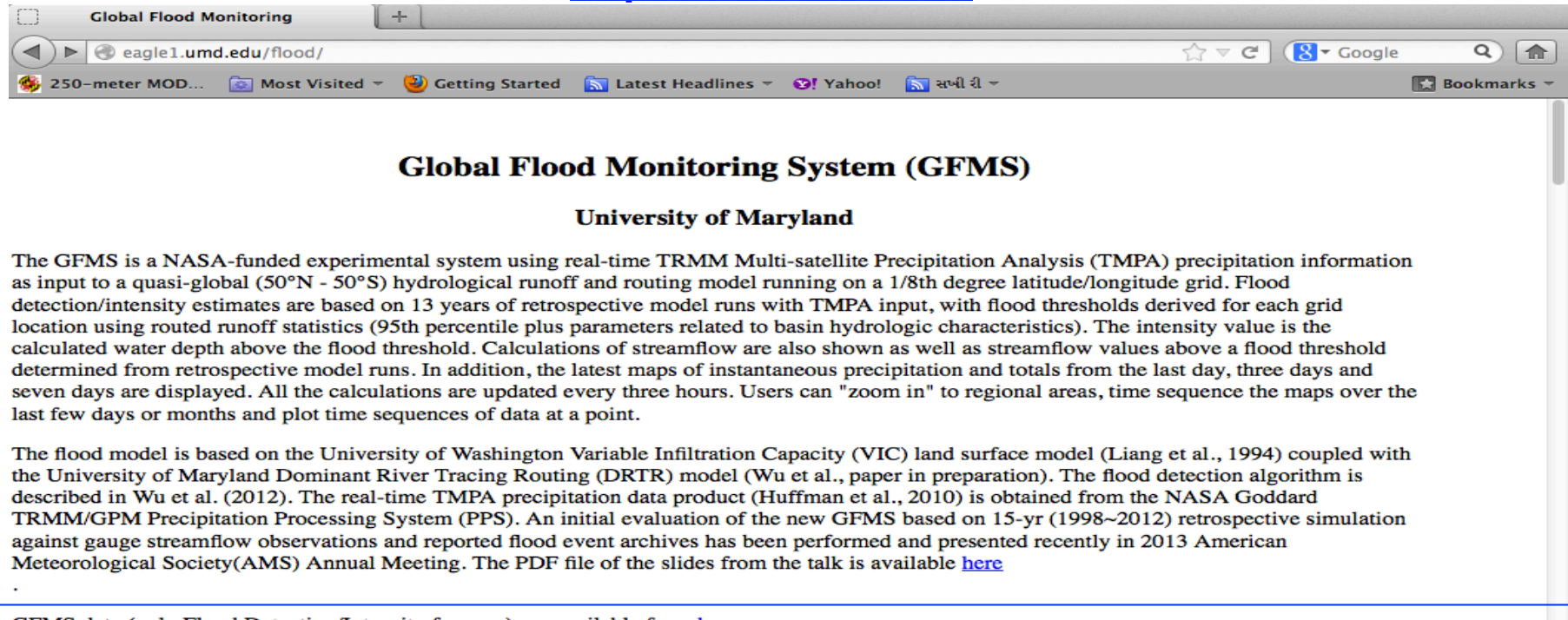
Can Zoom-in to
any region

Can be Viewed in
Google Earth

24-hour Forecast
based on NOAA
and NASA forecast
models available

Global Flood Monitoring System (GFMS)

<http://flood.umd.edu>

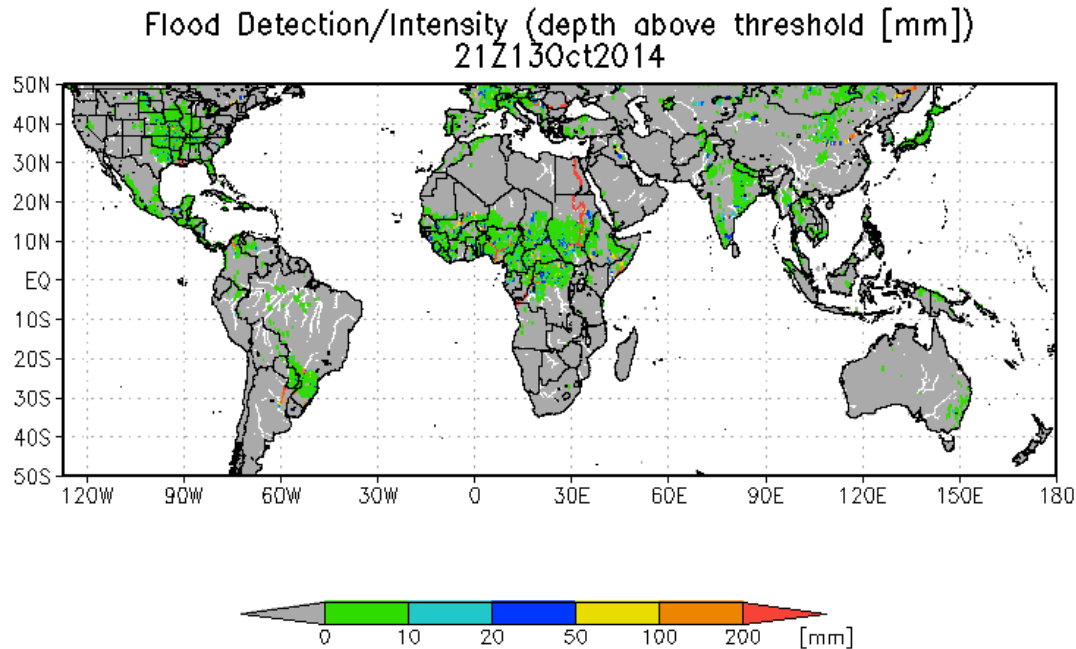


Provides global maps, time series, animation (50°S-50°N) of:

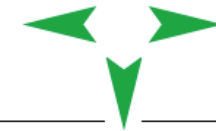
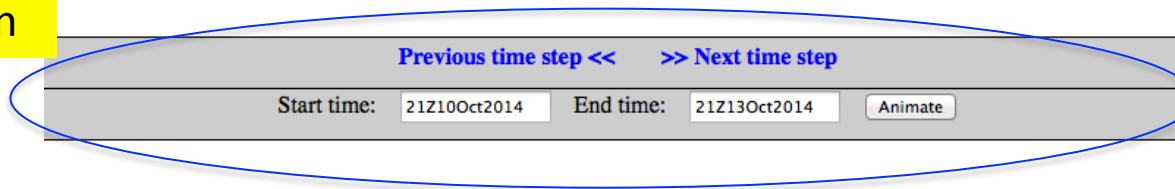
- **Instantaneous Rain**
- **Accumulated rain over 24, 72, and 168 hours**
- **Stream flow rates and flood detection at 1/8th degree (~12 km) spatial resolution**

Global Flood Monitoring System (GFMS)

<http://flood.umd.edu>



Temporal
Selection



[↑]
Zoom in

[↑↑↑]
Zoom out

Spatial
Selection

Plot time series for an
individual point (lat, lon):
(Tips: Zoom in enough to
click the point or define it
below)

-62.51 177.3

T1: 21Z10Oct2014

T2: 21Z13Oct2014

Plot different variable:

Flood Detection (Depth) ▾

- Inputs: TRMM and Multi-satellite Precipitation (TMPA)
Surface temperature and winds from MERRA
- Runoff generation from U. Washington Land Surface Model (Variable Infiltration Capacity)
- Runoff routing model from U. Maryland

Inundation Mapping Tools based on MODIS

Dartmouth Flood Observatory

<http://floodobservatory.colorado.edu/>

[Home](#)

[Active
Archive of
Large
Floods,
1985-Present](#)

- [Global
and
Regional
Analyses](#)

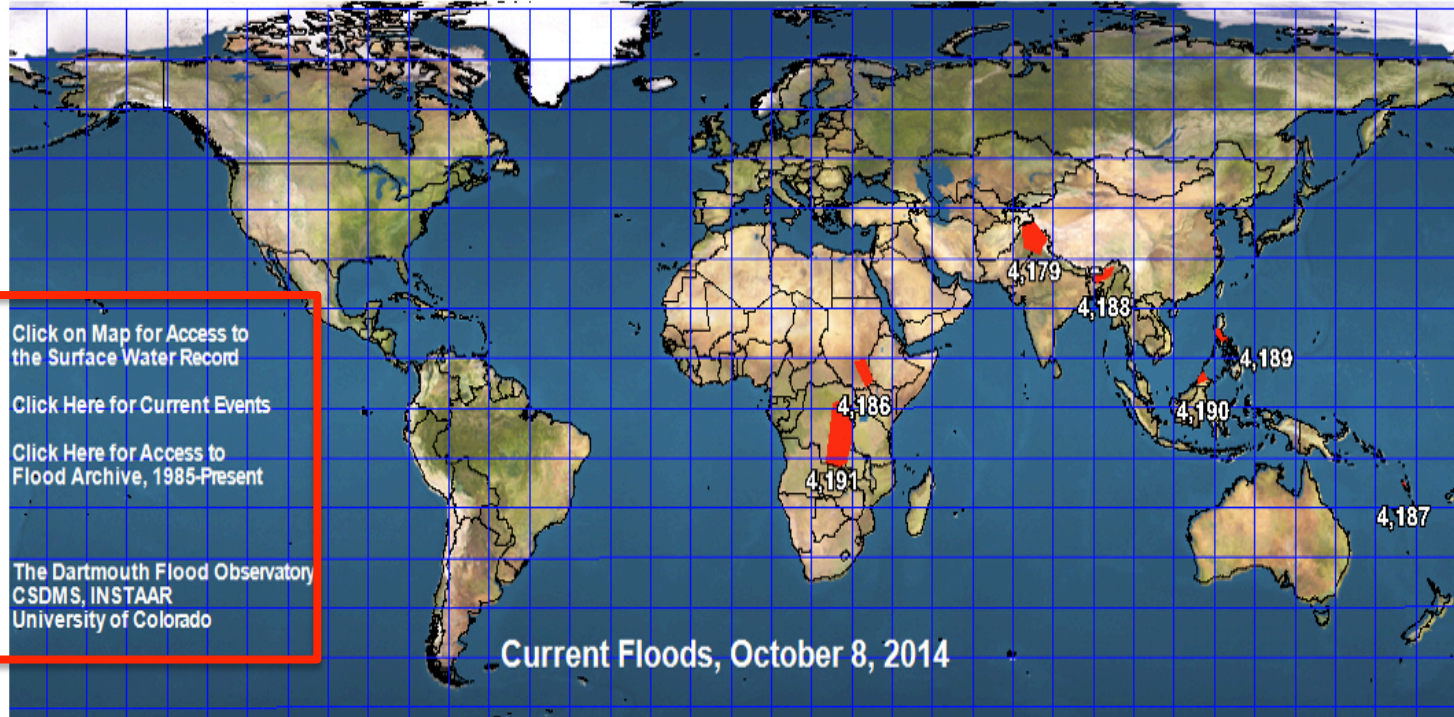
[Master Index
of
Inundation
Maps](#)

[The Surface
Water
Record](#)

[River Watch](#)

[Other Flood
Detection
Tools](#)

[Sample
Images and
Maps](#)

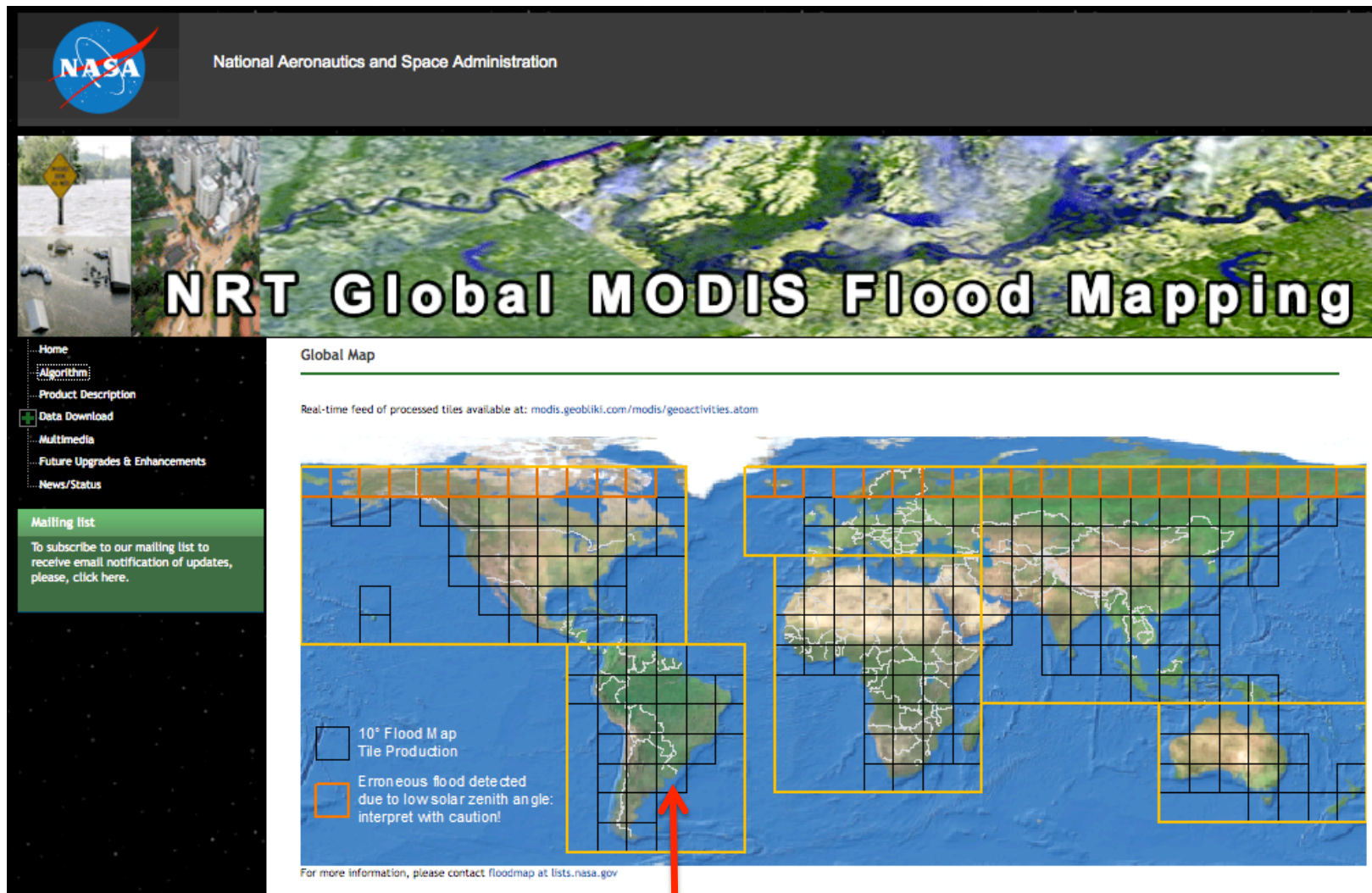


MODIS data are used to map inundation

Experimental, River Discharge available from satellite (aqua, TRMM, GCOM-W) data


MODIS Inundation Mapping

<http://oas.gsfc.nasa.gov/floodmap/>




MODIS Inundation Mapping

<http://oas.gsfc.nasa.gov/floodmap/>



National Aeronautics and Space Administration



NRT Global MODIS Flood Mapping

- Home
- Algorithm
- Product Description
- Data Download**
- Multimedia
- Future Upgrades & Enhancements
- News/Status

3 Day Composite2 Day Composite1 Day Composite14 Day Composite

« December 2013 »

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Products		Available Downloads	
MODIS Flood Map	MFM	png	
MODIS Flood Water	MFW	shapefile (.zip)	KMZ
MODIS Surface Water	MSW	shapefile (.zip)	KMZ
MODIS Water Product	MWP	geotiff	
README		pdf	txt

Check slide show for the last 10 days.

\mathcal{N}
↑
 $\mathcal{W} \leftarrow \rightarrow \mathcal{E}$
↓
 \mathcal{S}

Archive
Available

Composite
Map

10-day
Sequencing

png, kmz,
geotiff images
available

Severe Flooding in Bolivia

January-March 2014



Bolivia: 29 killed in torrential rains so far this year



Cochabamba is among the provinces worst hit by the heavy rains

Officials in Bolivia say the number of people who have died due to torrential rain since the beginning of the year has risen to 29.

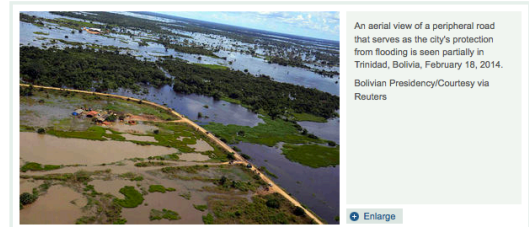
Related Stories

Latin America
MONITOR

Bolivia under water: Why no national disaster declared amid floods?

The Bolivian government says its massive aid operation, which includes food and tents, is well underway, but not everyone is satisfied with the response.

By Sara Shahriri, Correspondent / February 21, 2014



Bolivia floods kill 38, more heavy rains forecast

LA PAZ | Thu Feb 6, 2014 6:13pm EST

0 COMMENTS | Tweet 15 | Share 1 | Share this 8+1 7 | Email | Print



2 OF 2. Women disembark from a helicopter after being rescued from their flooded homes, in Trinidad, some 400 km (249 miles) northeast of La Paz February 5, 2014. CREDIT: REUTERS/DAVID MERCADO

Live Demo :
GFMS and MODIS Inundation Tool
Importing MODIS Surface Water Data in GIS

Ecological Forecasting



(Photograph ©2006 [Stefan Gara](#).)

Amazon Deforestation



July 20, 2000



August 21, 2009

Ecological Forecasting

Ecological Forecasts using Satellite data products and models



To identify disturbances that threaten the extent and function of ecosystems



Ecosystem Management by policy and decision makers

Land Management Issues

- Growing populations
- Less natural resources
- Changing climate
- Urban growth



Source: www.icid.org



Source: polarbearsinternational.org

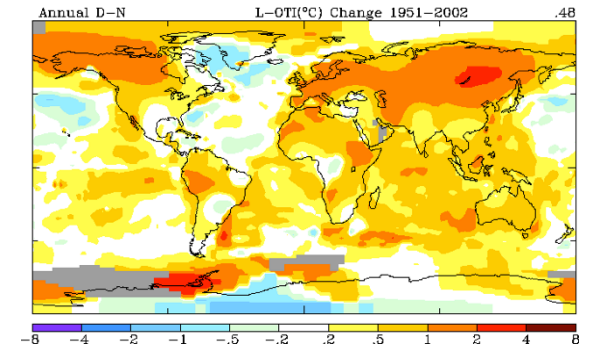
- Habitat loss
- Declining biodiversity
- Invasive species
- Desertification
- Deforestation



Source: naturemappingfoundation.org

Monitoring Ecosystem Change

- NASA Earth science questions with respect to ecosystems:
 - How are global ecosystems changing in extent and function?
 - How do ecosystems respond to and affect global environmental change and the carbon cycle?
- Climate change:
 - Although climate change is a global phenomenon....
 - The effects of climate change on ecosystems are local and heterogeneous

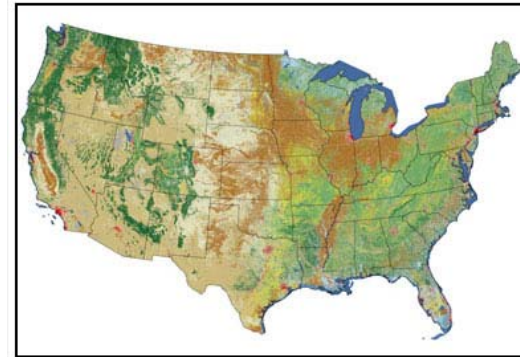


NASA Satellite Instruments for Land Resources Management

Satellite	Sensor(s)	Applications
Landsat (4, 5, 7, 8; LDCM)	Landsat TM, ETM+, Operational Land Imager (OLI), Thermal Infrared Sensor (TIRS)	Agricultural Efficiency, Carbon Cycle, Coastal Management, Ecological Forecasting, Invasive Species Monitoring
Terra, Aqua	MODerate Resolution Imaging Spectroradiometer (MODIS)	Agricultural Efficiency, Carbon Management, Ecological Forecasting, Coastal Management
EO-1	Hyperion, Advanced Land Imager (ALI)	Agricultural Efficiency, Carbon Management, Ecological Forecasting, Coastal Management
Suomi NPP	Visible Infrared Imager Radiometer Suite (VIIRS)	Carbon Cycle, Ecosystems, and Biogeochemistry, Climate Variability and Change

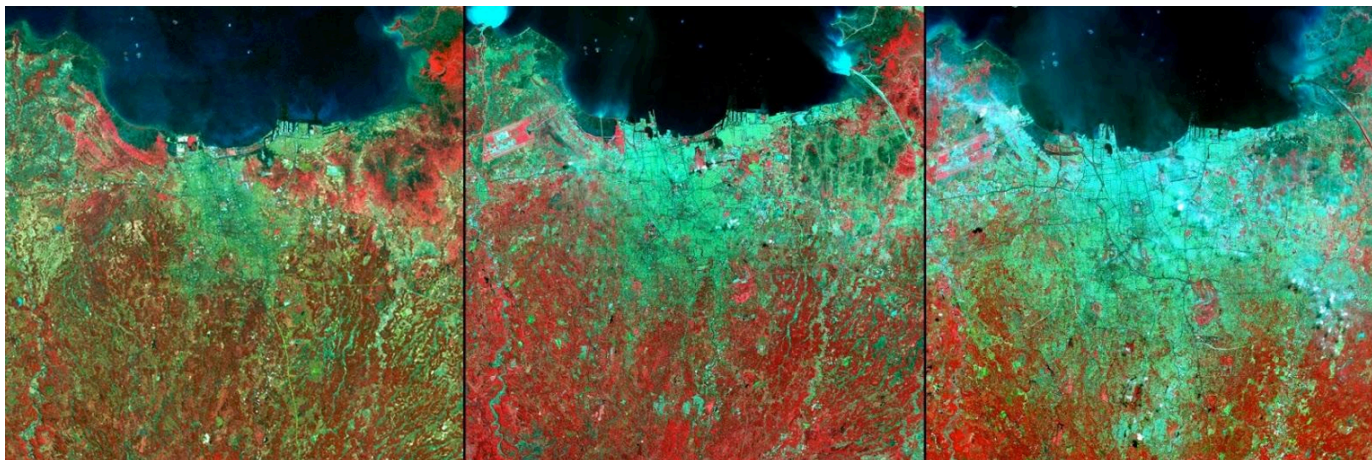
Monitoring Ecosystem Change with Satellite Imagery

- Identify Landsat derived land cover
- Monitor change over time



<http://www.mrlc.gov/nlcd2011.php>

While land cover can be observed on the ground or by airplane, the most efficient way to map it is from space.

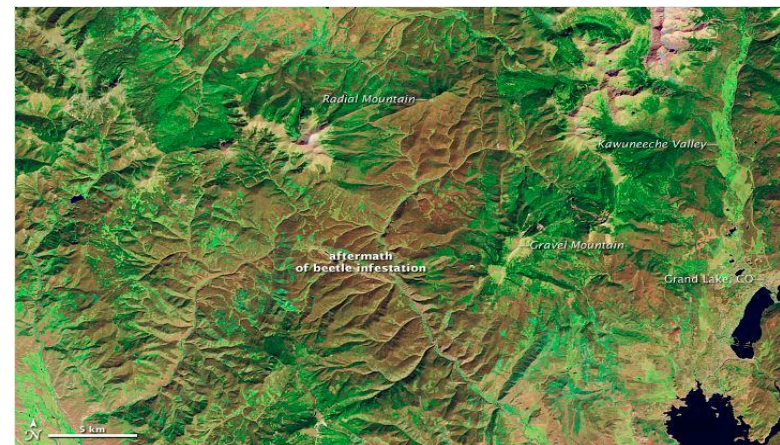


Urban growth from 1976, 1989 to 2004 in Jakarta, Indonesia

Source: NASA Earth

Land Cover Change Detection by Satellites can be Applied to:

- Deforestation assessments
- Vegetation phenology by vegetation indices
- Monitor urban growth
- Forest disturbance assessments
- Invasive species monitoring
- Land Cover identification
- Ecological restoration
- Habitat suitability assessments

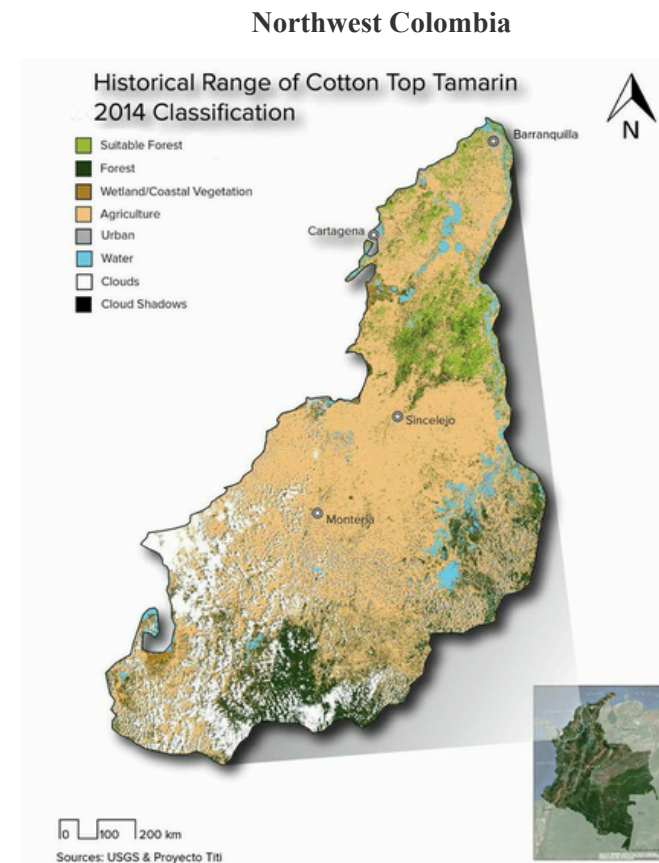


Bark beetle infestation in Colorado between 2005 and 2011

Source: earthobservatory.nasa.gov

Satellite Data Applications: Species Conservation and Habitat Suitability

- Cotton-top tamarin
- Critically Endangered (IUCN)
- Deforestation, urbanization
- Landsat imagery and land cover
- Historical range versus current and projected land use, land cover
- Proposed areas for restoration, preservation, habitat corridors



By [DEVELOP](#), posted on August 3rd, 2014 in [DEVELOP Summer 2014 VPS](#)

Project Team: Colombia Ecological Forecasting Team

Team Location: University of Georgia, Athens, Georgia

Ecosystem Function and Services

Provisioning Services

- food
- wood
- fuel
- freshwater
- medicines
- habitat for biodiversity
-



<http://devoteddads.files.wordpress.com/2007/10/treeroots.jpg>

Regulating Services

- air quality regulation
- water filtration
- prevents coastal erosion
- carbon sequestration
- nutrient cycling
- pollination

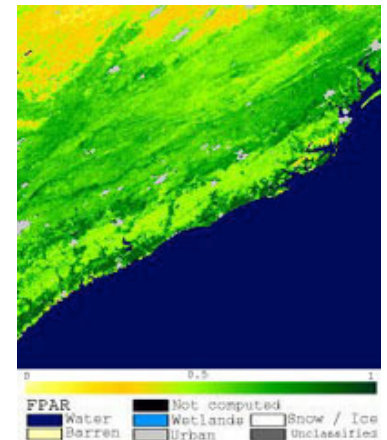
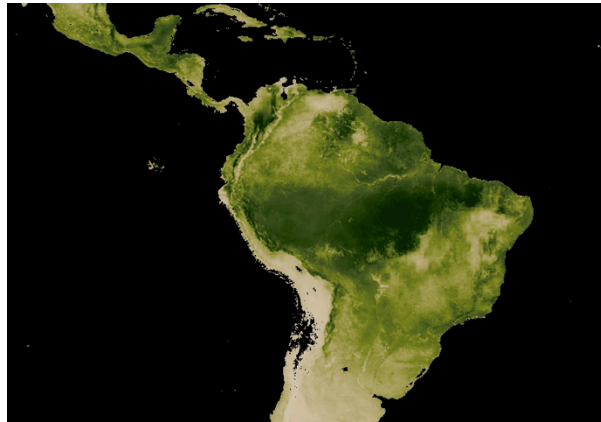


<http://www.environmentmagazine.org/sebin/v/x/ecosystem-photo2.jpg>

Remote Sensing Applications: Ecosystem Function and Services

Carbon Sequestration

- MODIS Leaf Area Index and Net Primary Production



Coastal protection, Biodiversity

- Landsat, MODIS imagery and land cover maps
- Sea surface temperature



Ecosystem Forecasting can be Applied to Global Conservation Initiatives

REDD + activities



Habitat Suitability, Species Conservation



Ecosystem Risk Assessments

Climate Change Forecasting/ Mitigation

Ecosystem Service Accounting



Ecosystem Restoration



Where to Obtain MODIS Land Products

- **ECHO Reverb** <http://reverb.echo.nasa.gov>
- **Data Subsetting and Visualization: Oakridge National Lab DAAC (ORNL DAAC)** <http://daac.ornl.gov>
- **GLCF** <http://www.landcover.org/data/lc>
- **GLOVIS** <http://glovis.usgs.gov>
- **Visualization: SERVIR**
<https://www.servirglobal.net/Global/MapsData/InteractiveMapper.aspx>

Where to Obtain Landsat Images

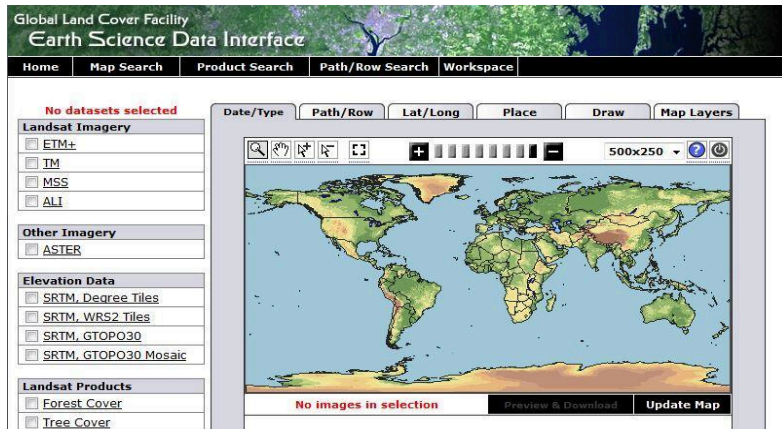
The LandsatLook Viewer

<http://landsatlook.usgs.gov/>



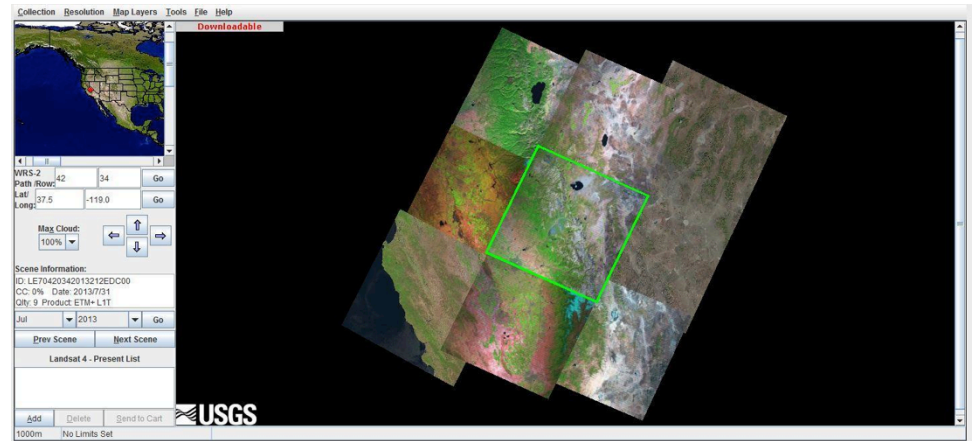
Global Land Cover Facility

<http://glcfapp.glcf.umd.edu>



GloVis

<http://glovis.usgs.gov>



Earth Explorer

http://



Agriculture

Satellite Data can be applied to agriculture:

- For sustainable and productive agricultural practices and increased food security
- To assess water availability and drought forecasting
- Application of vegetation indices, soil moisture and rainfall data for increased crop yields, soil conservation



Types of Drought



Meteorological Drought: Deficient rainfall over specific period

Agricultural Drought: precipitation shortages resulting in soil moisture deficits, reduced vegetation/crop.



Hydrological Drought: depletion of surface or subsurface water supply i.e., streamflow, reservoir and lake levels, groundwater.

Agricultural Applications of NASA Data Products

- Health of crops, monitor stages of growth (phenology), potential yield, soil conditions, invasive species or stress extent
- Direct humanitarian efforts due to forecasted drought

Data products:

Landsat imagery	Soil Moisture
MODIS NDVI/EVI	Evapotranspiration
TRMM rainfall rates	

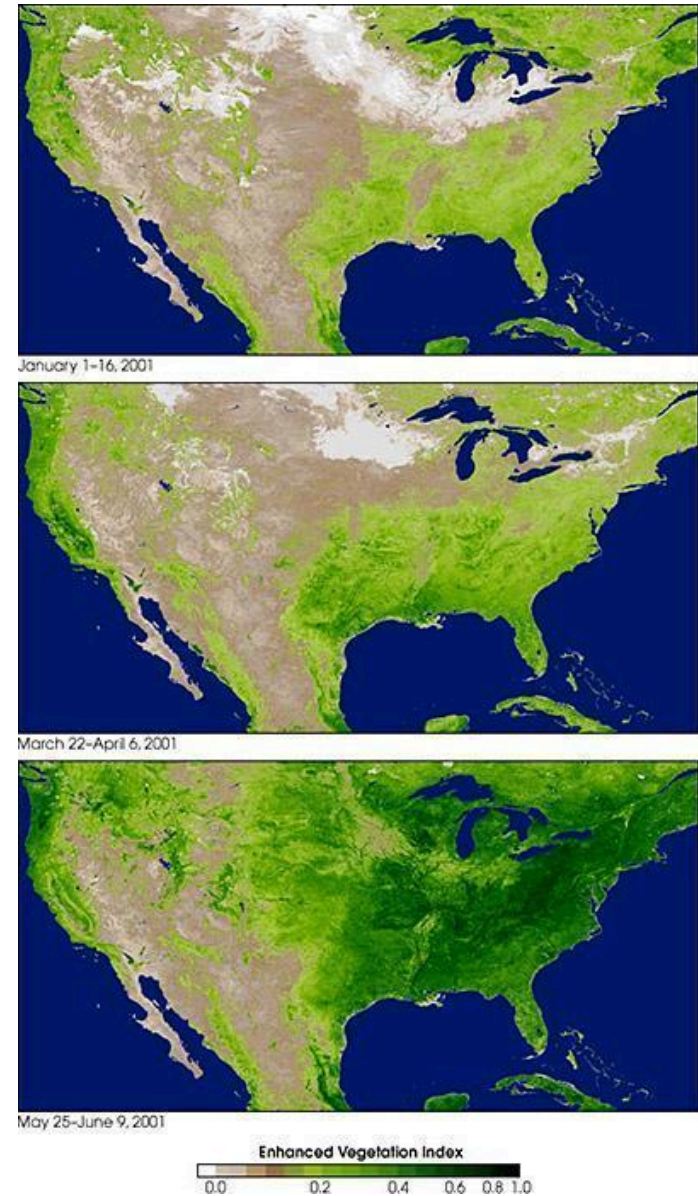
Satellite	Sensor(s)
TRMM	TMI, PR
Landsat 7	Landsat ETM+
Landsat 8 (LDCM)	Operational Land Imager (OLI), Thermal Infrared Sensor (TIRS)
Terra, Aqua	MODerate Resolution Imaging Spectroradiometer (MODIS)
Terra	ASTER
EO-1	Hyperion, Advanced Land Imager (ALI)
Suomi NPP	VIIRS

MODIS Land Products: Vegetation Indices

- **NDVI** (Normalized Difference Vegetation Index): Ratio between the red and the Near-Infrared bands
- **EVI** (Enhanced Vegetation Index): Addition of the blue band to account for atmosphere
- Used for: drought monitoring, phenology (timing of vegetation green-up)

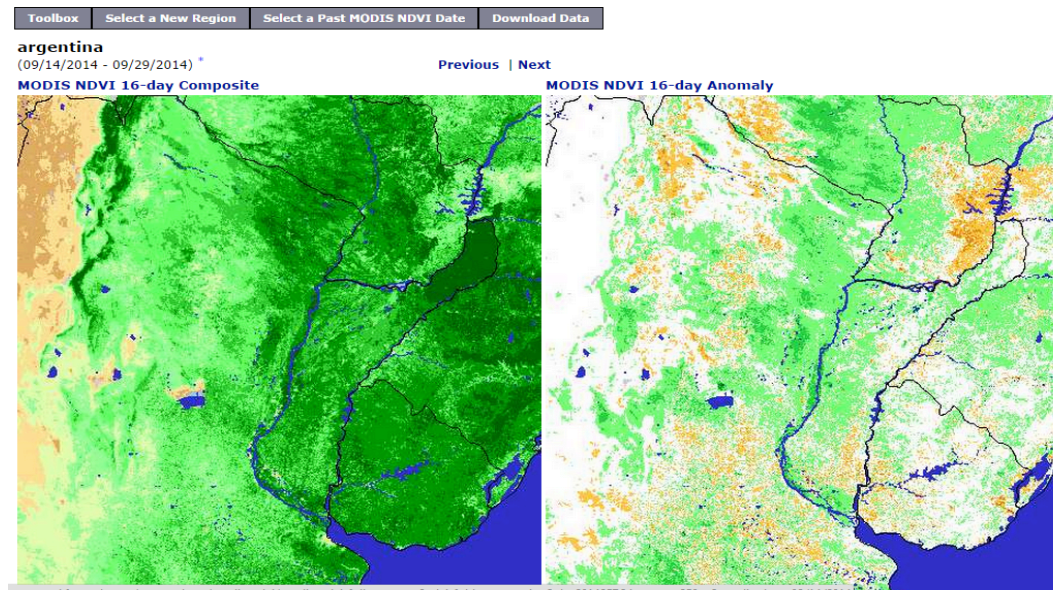
Vegetation index data demonstrates part of the seasonal cycle in the contiguous US during the first half of 2001

Credit: NASA/GSFC/University of Arizona

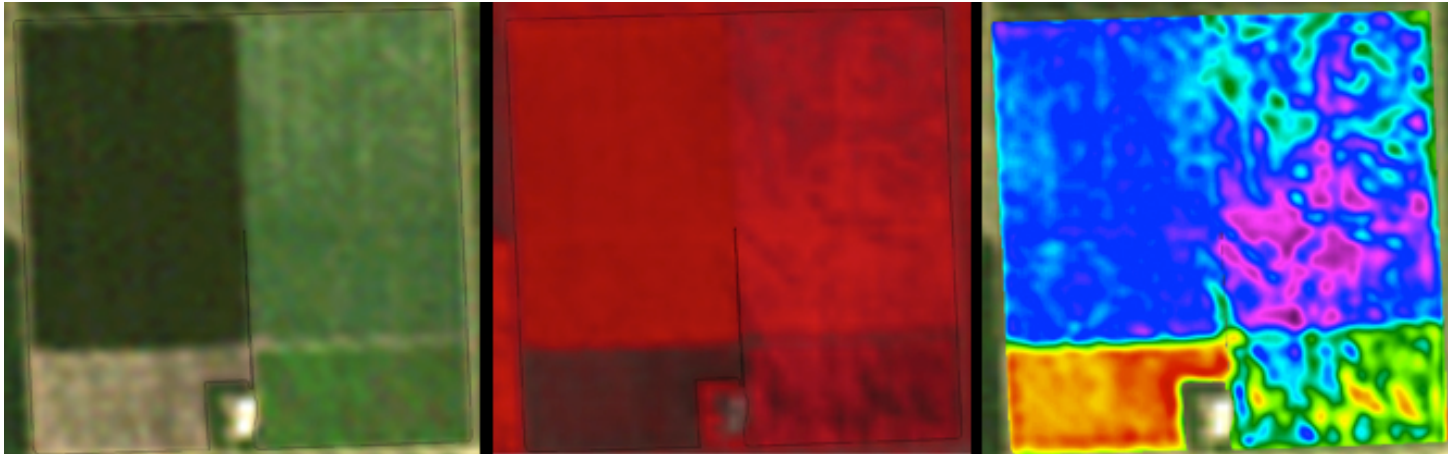


NDVI (Vegetation Index) to monitor crop health

- Comparing the NDVI (or greenness) of crops can assist in determining irrigation plans and precision farming
- To determine that the locations of stress on crops (lack of water, soil moisture, insects, disease)
- NDVI and surface temperature data information to inform next year planting practices
- Hindcast, or use past observations to determine best practices



Landsat Imagery



http://www.nasa.gov/mission_pages/landsat/news/sweet-spot_prt.htm

- To determine proper crop location, irrigation needs, placement of fertilizer
- Landsat Band Combination: 4-3-2 (near infrared, red, and green bands)
- Maximize yields

Agricultural Drought

Krishna River Basin, India

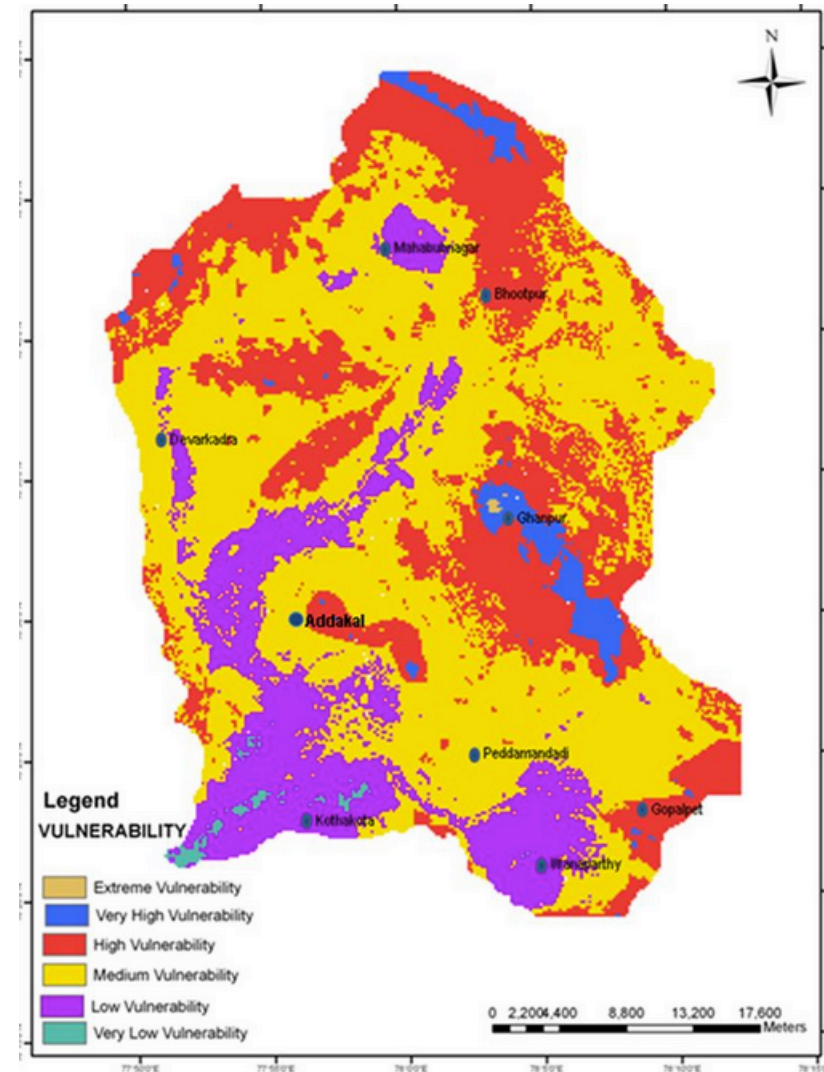
Satellite data:

Landsat Enhanced Thematic Mapper (ETM) Imagery

Terra ASTER DEM (elevation)

Soil moisture, precipitation

Combined with drainage density and
soil type layers in GIS can be used to
create drought vulnerability maps



Sreedhar et al., 2012

Data Access and Portals for download and Visualization

Giovanni (<http://disc.sci.gsfc.nasa.gov/giovanni>)

soil moisture, evapotranspiration, rainfall rate, runoff, snowmelt

LP DAAC, ONRL DAAC, LandsatLook Viewer (<https://lpdaac.usgs.gov/>, <http://daac.ornl.gov/>, <http://landsatlook.usgs.gov/>)

net primary production, EVI/NDVI, Landsat Spectral Bands

Global Agriculture Monitoring (GLAM) Project

(<http://pekko.geog.umd.edu/usda/beta/>)

Crop Explorer (<http://www.pecad.fas.usda.gov/cropexplorer/>)

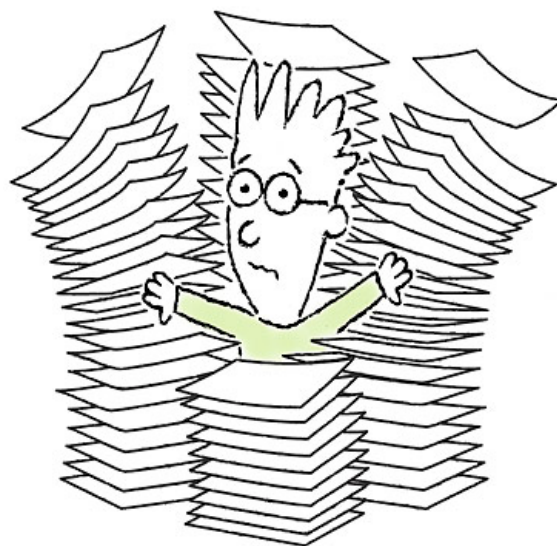
SERVIR Global (<https://www.servirglobal.net/>)

Live Demonstration of:

- > GEO-GLAM/Crop Monitor**
- > LandsatLook**

Summary of the Webinar

Introduction to NASA Earth Science Data Products, Portals, and Tools



A lot of introductory information and overview of data and tools in five 1-hour sessions!

We used many acronyms !

Acronym Directory:

<http://gcmd.gsfc.nasa.gov/learn/faqs/acronyms.html>

Week-1: (<http://science.nasa.gov/earth-science/>)

NASA Earth Science: Climate System Research
Technology Development → Many Satellite Missions, Earth System Models
Applications for Societal Benefits
Capacity Building and Trainings, About ARSET

Week-2: (Global Change Master Directory)

<http://gcmd.gsfc.nasa.gov/index.html>

Data for Environmental Applications: (*Products, Sources, Attributes, Data Search*)

Air Quality

Disasters

Eco-forecasting and Land Management

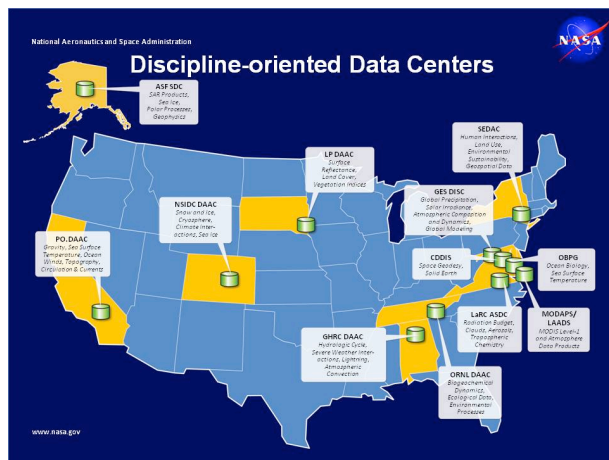
Water Resources

Week-3: <https://earthdata.nasa.gov/>

NASA's Earth Observing System Data and Information System (EOSDIS)

NASA Data Centers, Data Access, Analysis, Visualization Tools

12 Data Centers



Near-real Time Data Access and Visualization Tools

LANCE
Worldview
Reverb-ECHO

Remote Sensing and Model Data Archive

Mirador
Giovanni
NSIDC
CALIPSO Search and Subsetting
LAADS Web
USGS – LP DAAC, EarthExplorer, GloVIS
ORNL
PO DAAC Data Discovery

Summary

Week-4 & 5 :

Data Products, Tools, Applications, Live Demo including GIS Applications for:

Air Quality, Water Resources, Disasters, Eco Forecasting/Land Management

Satellites: Terra, Aqua, TRMM and GPM, Landsat, GRACE, CALIPSO

Models: MERRA, GLDAS, NLDAS

Live Demo: Worldview (**air Quality**), Giovanni and GIS (**Water Resources**), GFMS, MODIS Inundation Mapping (**Disasters**), Crop Explorer/GEO-GLAM, LandsatLook (**Eco Forecasting and Land Management**)

To Conclude ---

- **NASA DATA ARE FREE!**
- **Advanced training courses can be requested for specific applications and geographic regions from <http://arset.gsfc.nasa.gov/training> or by contacting ARSET personnel**

ARSET Contact Information

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Disasters (Extreme Weather, Flooding):	Amita Mehta	amita.v.mehta@nasa.gov
Eco Forecasting/Land Management:	Cynthia Schmidt	cynthia.l.schmidt@nasa.gov
Train the Trainers:	Brock Blevins	bblevins37@gmail.com
Water Resources:	Brock Blevins/Amita Mehta	(As Above)

Thank You!